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1 Scope:

This procedure describes the steps necessary to wind and cure a GSI coil. The coil is assembled and wound from insulated superconducting cable, wedges, wedge tips, end spacers and end saddles. The coil is then cured in the BNL long curing press.

2 Applicable Documents:

[RHIC-MAG-Q-1004](#)

[RHIC-MAG-R-7337](#)

25-1740.01-4

25-1850.01-5

[OPM 8.1.1.19](#)

[OPM 8.1.1.28](#)

[Discrepancy Reporting Procedure](#)

[Kapton Coil Insulation Damage](#)

Coil Scratch Protector

GSI Winding & Curing Tooling

[Operation of Short Coil Winder](#)

[Operation of Automated Long Coil Curing Press](#)

3 Requirements:

3.1 Material

None

3.2 Safety Precautions

3.2.1 All winding operators shall be qualified by the cognizant technical supervisor in the safe operation of the short coil winder, RHIC OPM-8.1.1.19, Operation of Short Coil Winder.

3.2.2 All curing operators shall be qualified by their cognizant technical supervisor in the safe operation of the coil curing press, RHIC-OPM 8.1.1.28.

3.2.3 All lifting and handling operations requiring overhead crane operations shall be performed by holders of valid Safety Awareness Certificates. They shall also be instructed in the use of the appropriate lifting device by the Technical Supervisor.

3.2.4 Hard hats are required during crane operations.

3.2.5 Safety glasses shall be worn when tension is applied to cable.

3.2.6 Gloves and safety glasses shall be worn while using degreasers.

3.2.7 Caution must be taken in the proper disposal of degreaser, pads, swabs and towels.

- 3.2.8 Proper eye protection (safety glasses, goggles) shall be worn while the hydraulic system is in use.
- 3.2.9 Specific steps of this procedure contain Electrical & Mechanical Assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.
- 3.2.10 Entanglement with rotating machinery/moving parts can occur if loose fitting clothing or hanging jewelry is worn or if long hair is not tied up.
- 3.2.11 Do not use if a test of interlocks were not performed within the last six months and the dated Interlock Test Form is not posted near machines.
- 3.2.12 Sharps (i.e., razor blades) shall be disposed of per the Regulated Medical Waste Management SBMS Subject area (<https://sbms.bnl.gov/standard/0p/0p01d011.htm>).

4 Procedure

4.1 Mandrel, Centerpost, Blade and Formblock Cleaning

- 4.1.1 Start up short coil winder following the "Start The Winder" procedure, Section 5.4 of the RHIC-OPM 8.1.1.19, "Operation of Short Winder".
- 4.1.2 Press "Reset" on the UNIDEX 400 controller.
- 4.1.3 Press «F5» "Machine " then «F5» "Slew", to enter "Joystick" mode. Position the mandrel drive and carriage to allow the mandrel to be installed onto winding machine.
- 4.1.4 Using overhead crane, (2)5/16" screw eyes, 6 ft. slings, and drive journals, carefully move curing mandrel and coil onto the winding machine. Insert shoulder bolts and tighten.

CAUTION

Hard hats are required when crane is in use. Failure to observe this caution may result in severe injury.

- 4.1.5 Remove all tapes from mandrel, centerpost and blade sections remaining from previous coil cure.
- 4.1.6 Inspect all tooling and fasteners for magnetization using gaussmeter. Demagnetize any tooling which reads greater than 10 gauss using the degausser.

CAUTION

Gloves and safety glasses shall be worn while using degreasers. Failure to observe this caution may result in skin and/or eye irritation.

- 4.1.7 Clean all tooling using scouring pads and degreaser to remove all foreign matter from surfaces to contact coil. Vacuum entire mandrel and formblock including thru-hole and threaded hole locations. Use cotton swab and degreaser to clean holes.
- 4.1.8 Inspect all tooling surfaces to contact coil for burrs or scratches. Deburr if necessary using vacuum to remove chips.
- 4.1.9 Wipe all tooling clean using degreaser and towel. Follow up with a clean tack rag.
- 4.1.10 Apply teflon tape HM-350 to the thin edge of pusher blades and to the centerpost straight section on both sides. Trim excess teflon tape.
- 4.1.11 Install centerpost on mandrel. Install straight section locating pins flush or up to .06 in. below centerpost top surface. Torque centerpost mounting bolts to 36 in/lbs.
- 4.2 Winding Mandrel Preparation
 - 4.2.1 Apply two coats of Frekote 700 to the entire winding mandrel, and to the centerpost and blades. Allow 5 minutes drying time between coats.
 - 4.2.2 Place coil end scratch protectors on lead and non-lead ends of the winding mandrel.
 - 4.2.3 Place a Mylar scratch protector (.014 in.-thick) over each mandrel end to cover drive slots. Tape to mandrel using Kapton adhesive tape (1.00 in. wide x .001 in. thick with .0015 in.-thick adhesive).
 - 4.2.4 Apply one coat of FREKOTE 700 to the scratch protectors.

CAUTION

Gloves and safety glasses shall be worn while using degreasers. Failure to observe this caution may result in skin and/or eye irritation.

- 4.2.5 Vacuum the winding machine top surface, spool carriage and mandrel drive boxes. Wipe these surfaces clean using degreaser and towel.
- 4.2.6 Vacuum the mandrel surface opposite the centerpost.

- 4.2.7 Apply Teflon coated fiberglass tape 1.375 in.-wide x .003 in.-thick with .003 in. adhesive to the mandrel surface opposite the centerpost to cover all holes along the entire length. Attach mandrel rotating supports to the mandrel on the side opposite the centerpost.
- 4.2.8 Vacuum cable guides, clamps and end retainer tooling. Wipe clean with degreaser and towel. Follow up with a clean tack rag.
- 4.2.9 Inspect condition of Teflon coated fiberglass tape and Mylar strips attached to the coil end retainers to verify that there are no tears, rips, or damage to the material. If damage exists, replace following paragraph 4.2.11, if no damage exists, continue with paragraph 4.2.12.
- 4.2.10 To prepare coil end retainers, (1) apply 1 layer of Teflon-coated fiberglass tape (.003 in.-thick with .003 in. adhesive) to the surfaces that face the coil and trim to fit. (2) Cut 2 strips of Mylar (.005 in. thick) to a size of 8 in. long x 1 in. wide.
- 4.2.11 Mount the end coil end retainers and the Mylar strips to the centerpost. Fold overhanging portion of Mylar strip over the top of the coil end retainers and secure with Kapton adhesive tape (1.00 in.-wide x .001 in.-thick with .0015 in. adhesive).

NOTE

Reposition the Mylar strip when adding coil end retainer extensions during the winding.

- 4.2.12 Inspect the coil parts kits, verify all parts are present and properly prepared. Check the parts kit drawing numbers and revision levels with the coil assembly drawing and parts list. If discrepancies are found, contact coil parts kitting technical supervisor or cognizant engineer.
- 4.3 Cable Preparation
 - 4.3.1 Record serial number of insulated superconductor cable to be used on traveler. Verify that total footage of cable remaining on spool is at least 270 feet as per the cable history segment card before starting to wind coil. This amount includes 15 feet for holding tension and 5 feet for length counter deviation.
 - 4.3.2 Record the serial no. of the coil to be wound and the cable segment number on the traveler.
 - 4.3.3 Complete cable history segment card on spool for coil. Subtract 250 foot length of cable for one coil. See Figure 1 for cable history segment card recording procedure. Attach copy of cable history segment card to coil winding traveler.

- 4.3.4 Record the coil start footage and coil end footage (relative to hub end) on the traveler.
- 4.3.5 Using a micrometer, determine and mark the thick side of the cable; mount the cable spool on the winding carriage with the thick side of the cable facing up.
- 4.3.6 Position the winder table, carriage and mandrel to begin "HOMING" operation as described in RHIC OPM 8.1.1.19, "Operation of Short Coil Winder", Sect. 5.7, "Starting a Fresh Winding".
- 4.3.7 When ready, press «F4» "abort" to exit "joystick" mode then «F3» "single" to go to "auto" mode, press enter. Press "1" then enter to begin "homing". Press "25" (winding file number), then press "enter".
- 4.3.8 Thread cable through guide rollers, tension sensor, and lump detector as described in Attachment 3 of RHIC OPM 8.1.1.19, "Operation of Short Coil Winder".
- 4.3.9 Apply a bead of solder to the end of the cable. Remove Kapton insulation from the end of the cable, trimming to match the lead slot in the centerpost. Fasten trimmed ends of insulation with Kapton adhesive tape .50 in.-wide x .0005 in.-thick with .0005 in. adhesive.

NOTE 1

Ensure unused solder is recycled or disposed of properly

NOTE 2

The cable insulation, made up of 2 layers of Kapton wrap, is removed after the cable end is soldered. This is to prevent the fraying of the cable during handling, which could possibly occur if the insulation were removed first.

- 4.3.10 Thoroughly clean the cable with degreaser and paper towel.
- 4.3.11 Apply a coat of Frekote 700 to the end of the cable. The coated area will start where the cable will leave the slot, extending around the lead end of the centerpost and $15 \pm .25$ in. into the straight section of the first turn.
- 4.3.12 Attach cable to centerpost by placing the end of the cable into the centerpost slot. Check that the cable is mounted with the thick edge up.

CAUTION

Safety glasses are required when tension is applied to cable. Failure to observe this

caution may result in eye injury.

- 4.3.13 Place the tension power ON/OFF switch and tension controller ON/OFF switch to the "ON" position. Switch tension control to "Auto" mode. Press one of the "Continue" pushbuttons. Verify digital read out of tension applied on the manual control console, reads 20 ± 3 lbs.
- 4.3.14 If the tension alarm sounds during coil winding operation, verify that the tension readout on the manual control console is correct. If so, continue winding. If the tension is not correct or the alarm continues to sound, notify the cognizant technical supervisor.
- 4.3.15 Turn lump detector on winding carriage to ON position and set with a .015 in. feeler gauge.
- 4.3.16 Mount cable guide/clamps to the centerpost and clamp cable.
- 4.4 Winding Of Turns #1 Thru #4

NOTE 1

Turn numbering designation is for coil winding purposes only. Turn number will be displayed on the upper display panel located on the control console.

NOTE 2

The automatic controls on the coil winder will automatically stop the winding carriage at each coil end. At this point the lower display panel will display part name and number to be installed at this location. After installing specified part the continue switch shall be activated. The winding carriage will proceed to opposite coil end for process to be repeated.

- 4.4.1 Start coil winding by pressing any of the "Continue" switches mounted on winder table.
- 4.4.2 Bring the first turn of the insulated superconducting cable around lead end of the centerpost and lightly tap into place using rawhide mallet and delrin tapping tool so it lies firmly against the centerpost and mandrel.
- 4.4.3 Complete winding of Turn #1 by bringing the cable around the non-lead end and continuing back to the lead end.

NOTE

To hold cable and parts in place during winding, adjust clamps and re-secure cable at each clamp location.

- 4.4.4 Verify 40 ± 3 lb. cable tension is applied.
- 4.4.5 Wind Turn #2 around the lead end and along the straight section to the non-lead end.
- 4.4.6 Insert Solid End Spacer #2 at the non-lead end.
- 4.4.7 Wind Turn #2 around the non-lead end and along the straight section to the lead end.
- 4.4.8 Insert Solid End Spacer #1 at the lead end.
- 4.4.9 Wind Turn #3 around the lead end and along the straight section to the non-lead end.
- 4.4.10 Insert Solid End Spacer #4 at the non-lead end.
- 4.4.11 Wind Turn #3 around the non-lead end and along the straight section to the lead end.
- 4.4.12 Insert Solid End Spacer #3 at the lead end.
- 4.4.13 Wind Turn #4 around the lead end and along the straight section to the non-lead end.
- 4.4.14 Insert Solid End Spacer #5 at the non-lead end.
- 4.4.15 Wind Turn #4 around the non-lead end and along the straight section to the lead end.
- 4.5 Insert Wedge #1 And Wind Turn #5
- 4.5.1 Install Wedge-Wedge Tip Assembly 1AB. Install end spacer lamination at the lead end.

NOTE 1

The wedges must be placed into the coil so that the markings are placed on the outer radius surface.

NOTE 2

Wedge-wedge tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing.

NOTE 3

Wedge tips are positioned under Laminated Assembly End Spacers.

- 4.5.2 Wind Turn #5 around the lead end and along the straight section to the non-lead end.
- 4.5.3 Install Wedge-Wedge Tip Assembly 1CD.
- 4.5.4 Install End Spacer Lamination at the non-lead end, centered on coil axis.
- 4.5.5 Wind Turn #5 around the non-lead end and along the straight section to the lead end.
- 4.5.6 Install End Spacer Lamination at the lead end, centered on coil axis.
- 4.6 Wind Turns #6 Thru #12
 - 4.6.1 Wind Turn #6 around lead end and along straight section to the non-lead end.
 - 4.6.2 Install Solid End Spacer #7 at the non-lead end.
 - 4.6.3 Wind Turn #6 around the non-lead end and along the straight section to the lead end.
 - 4.6.4 Insert Solid End Spacer #6 at the lead end.
 - 4.6.5 Wind Turn #7 around the lead end and along the straight section to the non-lead end.
 - 4.6.6 Insert Solid End Spacer #9 at the non-lead end.
 - 4.6.7 Wind Turn #7 around non-lead end and along straight section to the lead end.
 - 4.6.8 Insert Solid End Spacer #8 at the lead end.
 - 4.6.9 Wind Turn #8 around the lead end and along the straight section to the non-lead end.
 - 4.6.10 Insert End Spacer Lamination at the non-lead end, centered on coil axis.
 - 4.6.11 Wind Turn #8 around the non-lead end and along the straight section to the lead end.
 - 4.6.12 Wind Turns #9 thru #12, inserting end spacer laminations between individual turns at both ends (4 at LE, 4 at NLE).
- 4.7 Insert Wedge #2 And Wind Turn #13
 - 4.7.1 Install Wedge-Wedge Tip Assembly 2AB. Install end spacer lamination at the lead end.

NOTE 1

The wedges must be placed into the coil so that the markings are placed on the

outer radius surface.

NOTE 2

Wedge-Wedge Tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing.

NOTE 3

Wedge tips are positioned under Laminated Assembly End Spacers.

- 4.7.2 Wind Turn #13 around lead end and along straight section to the non-lead end.
- 4.7.3 Install Wedge-Wedge Tip Assembly 2CD.
- 4.7.4 Install end spacer lamination at the non-lead end, centered on coil axis.
- 4.7.5 Wind Turn #13 around the non-lead end and along the straight section to the lead end.
- 4.7.6 Install End Spacer Lamination at the lead end, centered on coil axis.
- 4.8 Winding Of Turns #14 Thru #23
- 4.8.1 Wind Turn #14 around the lead end and along the straight section to the non-lead end.
- 4.8.2 Install Solid End Spacer #11 at the non-lead end.
- 4.8.3 Wind Turn #14 around the non-lead end and along the straight section to the lead end.
- 4.8.4 Install Solid End Spacer #10 at the lead end.
- 4.8.5 Wind Turns #15 thru #20, inserting End Spacer Laminations between individual turns at both ends (5 at LE, 6 at NLE).
- 4.8.6 Insert Solid End Spacer #12 at the lead end.
- 4.8.7 Wind Turn #21 around the lead end and along the straight section to the non-lead end.
- 4.8.8 Insert Solid End Spacer #13 at the non-lead end.
- 4.8.9 Wind Turn #21 around the non-lead end and along the straight section to the lead end.
- 4.8.10 Insert Solid End Spacer #14 at the lead end.

- 4.8.11 Wind Turn #22 around the lead end and along the straight section to the non-lead end.
- 4.8.12 Insert Solid End Spacer #15 at the non-lead end.
- 4.8.13 Wind Turn #22 around the non-lead end and along the straight section to the lead end.
- 4.8.14 Insert Solid End Spacer #16 at the lead end.
- 4.8.15 Wind Turn #23 around the lead end and along the straight section to the non-lead end.
- 4.8.16 Insert Solid End Spacer #17 at the non-lead end.
- 4.8.17 Wind Turn #23 around the non-lead end and along the straight section to the lead end.
- 4.9 Insert Wedge #3 And Wind Turn #24
- 4.9.1 Install Wedge-Wedge Tip Assembly 3. Install end spacer lamination at the lead end.

NOTE 1

The wedges must be placed into the coil so that the markings are placed on the outer radius surface.

NOTE 2

Wedge-Wedge Tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing.

NOTE 3

Wedge tips are positioned under Laminated Assembly End Spacers.

- 4.9.2 Wind Turn #24 around the lead end and along the straight section to the non-lead end.
- 4.9.3 Install Wedge-Wedge Tip Assembly 3.
- 4.9.4 Install End Spacer Lamination at the non-lead end, centered on coil axis.
- 4.9.5 Wind Turn #24 around the non-lead end and along the straight section to the lead end.
- 4.9.6 Install End Spacer Lamination at the lead end, centered on coil axis.
- 4.10 Winding Of Turns #25 Thru #32
 - 4.10.1 Wind Turns #25 thru #32, inserting End Spacer Laminations between individual turns at both ends (7 at LE, 8 at NLE).
 - 4.10.2 Wind Turn #32 up to, but not around, lead end. The upper display panel on the control panel will read: "Turn = 32", and the lower display panel will read: "WINDING DONE".
 - 4.10.3 Count the number of turns: there should be a total of 32 turns in the coil. Verify that all parts have been installed correctly.
- 4.11 Clean And Attach Blades
 - 4.11.1 Apply a coat of Frekote 700 to the end of the cable. The coating should cover the cable from the end of the straight section to the end of the mandrel.
 - 4.11.2 Clamp cable to the mandrel using a soft piece of rubber around the cable and a hose clamp, be sure not to damage cable.

NOTE

The hose clamp will be removed prior to placing the coil in the formblock

- 4.11.3 Turn "OFF" the cable spool tensioner by placing the Trac I Tension Controller ON/OFF toggle switches in the "OFF" position. Set the tension control potentiometer to ZERO. Turn off Lump Detector.

- 4.11.4 Apply Kapton adhesive tape (1.00 in.-wide x .001 in.-thick with .0015 in. Adhesive) where the cable is to be cut. Cut cable, leaving a $21 \pm 2/0$ in. Lead from coil end saddle. Roll up lead and tape to mandrel.

NOTE

Place strips of .002” tape on both sides of tabs to prevent insulation damage.

- 4.11.5 Clip off Kapton spacer tabs – use extreme caution not to damage Kapton insulation.
- 4.11.6 Set coil winder to “Joystick” mode by pressing <F4> “ABORT” once. Then <5> “SLEW”.
- 4.11.7 Rotate coil so it is in position to accept the pusher blades. Install pusher blades. Release cable clamps as required. Secure pusher blades, tighten screws to contact then back off 1/8 turn.
- 4.11.8 Place velcro straps every 18 inches over the blade assembly and coil. Tighten straps to make a tight coil package. Rotate coil until centerpost is facing up.
- 4.12 Prepare Ends

NOTE

Perform each step of Section 4.12 for both lead and non-lead ends.

- 4.12.1 Clamp coil end with 2 tie wraps.
- 4.12.2 Loosen coil end retainer extensions and remove the winding tooling from the coil end.
- 4.12.3 Clamp coil end with at least 1 clamp assembly positioned over last inch of centerpost tip.
- 4.12.4 Attach end pusher spacers to each coil end saddle. Be sure correct end pusher spacers are used on each coil end saddle.
- 4.12.5 Install end saddle and position against outside coil turn. Be sure scratch protector does not become pinched between coil and end saddle.
- 4.12.6 Secure saddles to mandrel by applying Kapton adhesive tape (.75 in.-wide x .0005 in.-thick with .0005 in. adhesive) over end pusher spacers.

4.13 Teflon Wrap Coil

- 4.13.1 Set the coil winder to the "Film Wrapping" mode by pressing <F4> "abort" then <F4> "run", toggle <F3> to "auto" type 2 for file #. See RHIC OPM 8.1.1.19, Sect. 5.9, "Film Wrapping". Press the "Continue" green pushbutton to rotate mandrel.

NOTE

Trim Teflon wrap around the centerpost keys using a razor.

- 4.13.2 Using 0.002 in.-thick x 4 or 6 in.-wide Teflon film, wrap the coil by hand holding the roll of Teflon film while rotating the coil/mandrel assembly. Use 44% to 48% (1/8" to 3/8" gap) overlap wrap. Remove clamp assemblies, velcro straps, and cable guides just ahead of wrapping. After Teflon wrap is complete, reinstall Velcro straps and clamp assemblies. At lead and non-lead ends, secure Teflon with Kapton adhesive tape (.75 in.-wide x .0005 in.-thick with .0005 in. adhesive). Use heat gun as necessary to shrink Teflon onto coil.

NOTE 1

Be sure to tape on sides of blade assembly when securing Teflon wrap with Kapton adhesive tape.

NOTE 2

Clamp assemblies will remain on the coil ends until coil is transferred to the curing fixture.

- 4.13.3 Rotate mandrel so coil midplane is facing down.
- 4.13.4 Loosen centerpost mounting bolts only until torque is removed.
- 4.13.5 Rotate coil/mandrel assembly with midplane facing up. Remove mandrel rotating supports from blade spacer.
- 4.13.6 Remove mandrel drive journal shoulder bolts from lead and non-lead ends.
- 4.13.7 Set the coil winder to "Initial Control Settings", section 5.3 as described in RHIC OPM 8.1.1.19, "Operation of Short Coil Winder".

CAUTION 1

Care shall be used to assure safe transfer of the coil/mandrel assembly to the curing fixture area. Failure to observe this caution can result in product damage.

CAUTION 2

Hard hats are required when crane is in use. Failure to observe this caution may result in severe injury.

- 4.13.8 Using overhead crane, eyebolts and slings, raise coil/mandrel assembly out of winder. Remove mandrel rotating supports from the centerposts. Transfer coil/mandrel assembly to curing press area.
- 4.14 Fixture Cleaning And Preparation For Cure
 - 4.14.1 Place coil end pushers in formblock against fully retracted threaded hydraulic cylinder rods. Be sure that lead end and non-lead end pusher bars are placed at proper end locations.
 - 4.14.2 Apply Frekote 700 mold release to the inside surface of the formblock. Let dry for five minutes.
 - 4.14.3 Remove clamp assemblies from coil ends.

CAUTION

Hardhats are required when overhead crane is in use. Failure to observe this caution may result in head injury.

- 4.14.4 Carefully lower mandrel/coil/blade assembly into the formblock using overhead crane and strongback assembly. The mandrel should be positioned using alignment pins on the ends of the formblock assembly.
- 4.14.5 Bolt the coil down into the formblock using through holes in the blade assembly and mandrel.
- 4.14.6 Torque each bolt three times minimum to assure the mandrel is seated properly. Use a spiral pattern starting with the center bolt. Torque 3/8" bolts to 408 in-lbs.
- 4.14.7 Connect thermocouples.
- 4.14.8 Attach mandrel hot oil lines.

NOTE

The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately disposed of as regulated industrial waste.

- 4.14.9 Set the pusher bar system to seat the end saddles against coil by manually pushing on end pushers.
- 4.14.10 Extend threaded hydraulic cylinder rods until they contact the end pusher bars. Insert shims if necessary.

CAUTION

Stand behind the formblock and use handles to move the formblock. Ensure no one is standing at the front of the formblock when it is moved. Failure to observe this caution may result in personnel injury.

- 4.14.11 Roll formblock assembly into press.
- 4.14.12 Install locking bar.
- 4.14.13 Check all hot oil lines for correct attachment.
- 4.14.14 Open all hot oil valves.
- 4.14.15 Check all nitrogen tank levels. Set regulators @ 5 psig.

CAUTION

Leaks from the heat exchanger have the potential to cause a regulatory violation. Inspect oil cooler for oil leaks before each cure. Report any leaks to the Plant Manager. If the leak has the potential to impact the environment, call extension 2222 to report immediately.

- 4.14.16 Inspect the fan cooled heat exchanger and piping system for leaking Therminol 59. Repair and report to the cognizant supervisor any leaks found. Continue to inspect hourly during the cure program.
- 4.14.17 Start up the press as per RHIC-OPM 8.1.1.28.
- 4.15 Cure Cycle

NOTE

The parameters for the automatic cure cycle and an explanatory sheet are given in Appendix B.

- 4.15.1 Start the automatic cure cycle. Follow the instructions as they are given on the computer screen.
- 4.15.2 When the cure cycle pauses after gap measurements are taken at 135⁰C, determine the correct shim size based on a memo from the cognizant engineer.
- 4.15.3 Select/assemble the cure shims. Verify the thickness of both with a micrometer and install them in the press.
- 4.15.4 Resume the automatic cure cycle.
- 4.15.5 When the cure cycle is complete, shut down the press as per RHIC-OPM 8.1.1.28.
- 4.15.6 Print computer cure summary sheet and attach to traveler.
- 4.16 Cured Coil Removal
- 4.16.1 Remove stop bar and roll formblock assembly out of press.
- 4.16.2 Remove thermocouples from mandrel only.
- 4.16.3 Turn off hot oil valves and disconnect hot oil lines. Cap all hot oil lines.

NOTE

The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately disposed of as regulated industrial waste.

- 4.16.4 Unbolt mandrel from formblock.

CAUTION

Hardhats are required when overhead crane is in use. Failure to observe this caution may result in head injury.

- 4.16.5 Using the overhead crane, (2) 5/16 in. screw eyes and 6 ft. slings, carefully move curing mandrel and coil onto the winding machine.
- 4.16.6 Start up short coil winder following the “Start the Winder” procedure, section 5.4 of the RHIC-OPM8.1.1.19, “Operation of Short Winder”.
- 4.16.7 Press “Reset” on the Unidex 400 controller, then [F5] “machine”, [F5] “slew” to enter “joystick/manual” mode. Position the mandrel drive and carriage to allow the mandrel to be installed onto the winding machine.

CAUTION

Do not rotate the mandrel until the blades are removed.

- 4.16.8 Attach mandrel drive journals to each end of mandrel and (2) straight section cable clamps to the centerpost. Lower the mandrel and cured coil onto winding machine, lining up journals with thru holes. Insert shoulder bolts and tighten.

CAUTION

Care must be taken when using a razor blade. Failure to observe this caution may result in personal injury.

- 4.16.9 Run razor blade horizontally along the top of the blades to cut the Teflon wrap. Do not cut against the blades; this might cause chips to be formed and damage the coil and blades.
- 4.16.10 Peel the Teflon wrap off the coil.
- 4.16.11 Using the hand held blade holders, remove the blades from the mandrel and place on the blade cart.
- 4.16.12 Attach mandrel rotating supports to the blade spacer on the side opposite the centerposts.
- 4.16.13 Rotate mandrel so that the centerposts are facing up. Remove straight section cable clamps from the centerposts.

- 4.16.14 Tighten the lead #1 and non-lead #5 center post mounting screws. Remove centerposts #3 & #4. Of the remaining centerpost mounting screws, remove the screws that are in straight thru holes.
 - 4.16.15 Remove the straight section locating pins. Remove centerpost #2, then slowly loosen the remaining centerpost screws. Remove centerposts #1 & #5.
 - 4.16.16 Remove coil end force rings from saddles at each end.
 - 4.16.17 With 2 Technicians, carefully lift coil off mandrel and transfer to coil assembly area.
 - 4.16.18 Using a non-conductive green marker, record coil serial number, part number and revision letter on the inside diameter of the non-lead end coil end saddle.
 - 4.16.19 Secure midplane and pole leads to coil with velcro straps.
 - 4.16.20 Using a fine cut file, remove the flashing from the coil end saddles. To avoid damaging the coil leads, temporarily fold them back and secure them with velcro straps.
 - 4.16.21 Roll up the coil excess leads and secure with tie wraps.
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- 5 Quality Assurance Provisions:
 - 5.1 The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.
 - 5.2 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.
 - 5.3 All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

Cable History

When a coil is wound from a "Segment" it becomes a "Sub-Segment". See example below. Segment start position is 8,000 ft. and it's in an increasing direction, 8,000 being the start or (lead) and 10,000 the end or (Hub). Add "Sub-segment" length (1,833 ft.) to the lead or start position to determine your next "Start Position", which would be 9,833 ft.

CABLE HISTORY CABLE NO. BNL-0-0-00000 SEG-A

Segment ID	Coil Wound/Sample	Segment Length	Segment Start Position	Date & Initial
A	Insulated Cable			2/28/93
A-1	Test Coil	1833	8000	3/10/93
			9833	

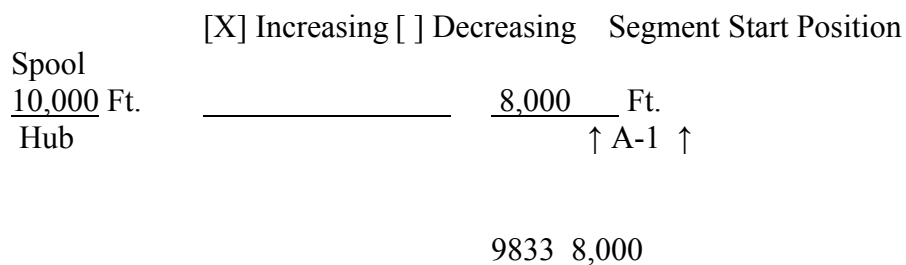


Figure 1

APPENDIX A

Coil Re-cure Procedure

Scope: This procedure describes the steps necessary to prepare a coil for re-curing.

1. Clean tooling by following steps in section 4.1.
2. Prepare mandrel and transfer to winding machine by following steps 4.2.1 through 4.2.8.
3. Apply a bead of solder to the end of the pole lead cable.
4. Apply a coat of Frekote 700 to the coil leads following step 4.3.11 and 4.11.1.
5. Remove locating pins from each end of the centerpost. Remove the lead and non-lead end centerpost section including the section with the slot for cable anchoring. Leave one straight section centerpost bolted to the mandrel.
6. Place coil onto the mandrel. Secure with three clamping ties, one at each end of the coil and one in the center.
7. Install lead and non-lead end centerpost sections onto mandrel. Install the lead end locating pin. Install bolts through the slotted holes of the centerpost sections. Hand tighten bolts to secure centerpost to mandrel.
8. Fasten cable end into centerpost slot and position centerpost on mandrel. Be sure the cable is flush with the centerpost top surface. Remove centerpost bolts from the centerpost section without slot. Align centerpost joints.
9. Position a 6 inch C-clamp with rubber protector on top of centerpost section with the lead slot and a phenolic block on bottom of mandrel (This is to prevent the C-clamp from damaging the top of the centerpost or the bottom of the mandrel).
10. Tighten C-clamp enough to allow the centerpost bolts to thread into mandrel. Tighten all centerpost bolts while maintaining force on the centerpost against the mandrel with the C-clamp. Align centerpost joint ends while seating the centerposts.
11. Install the non-lead end straight section locating pin.
12. Remove C-clamp. Rotate mandrel to accept blade assembly.
13. Attach end pusher spacers by following step 4.12.4.
14. Teflon wrap and prepare for curing by following steps in section 4.13.

APPENDIX B

Explanation of Cure Cycle Program

1. Program Steps:

00 HEAT to 135 ⁰ C	Heat the fixture to bring it from 25 ⁰ C to 135 ⁰ C while holding the coil under medium pressure (cycling).
01 1st Sizing Step @ 135 ⁰ C	Close the mold and hold the coil under high pressure while at 135 ⁰ C for 30 minutes to size the coil.
02 HEAT to 225 ⁰ C	Unload the coil completely and heat the fixture to bring it from 135 ⁰ C to 225 ⁰ C.
03A MOLD@ 225 ⁰ C	Hold the fixture @ 225 ⁰ C for 5 minutes while holding the coil under low pressure to bond the cable turns together.
03B Begin Cooling	Cool the fixture for 5 minutes while holding the coil under low pressure.
04 COOL to 135 ⁰ C	Unload the coil completely and cool to 135 ⁰ C.
05 2nd Sizing Step @ 135 ⁰ C	Same as Step 01.
06 COOL to 25 ⁰ C	Cool the fixture to 25 ⁰ C while holding the coil under high pressure (cycling).

NOTE 1

All temperatures listed are average mandrel temperatures.

NOTE 2

Cycling the hydraulic pressure allows release of stresses produced by non-uniform thermal expansion or contraction of the coil and curing fixture components.